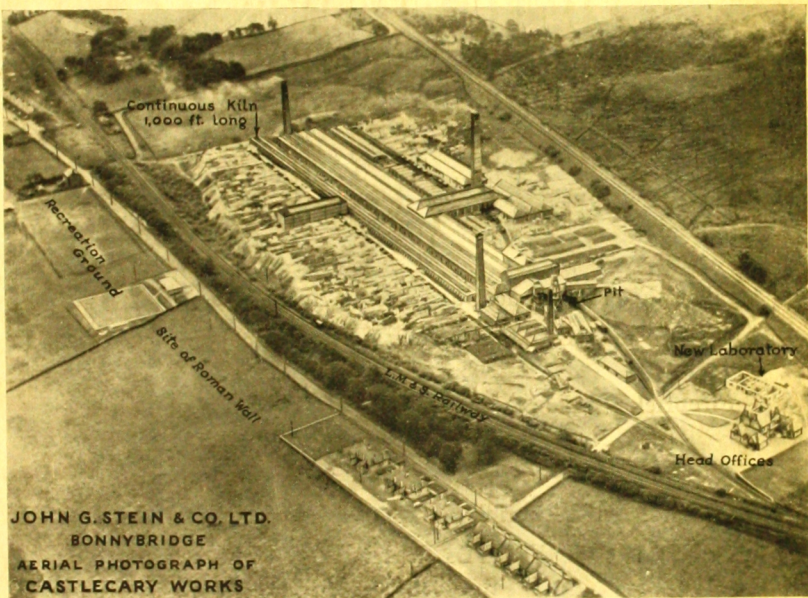


*L.T. Jefferys & Co*

# REFRACTORIES FOR IRON & STEEL WORKS BLAST FURNACES & COKE OVENS



**JOHN G. STEIN & CO., Ltd.**  
**BONNYBRIDGE**  
**SCOTLAND**

Largest Manufacturers  
in the British Empire

Our Technical Service  
is at Your Disposal



*Contractors to the*  
WAR OFFICE :: :: ADMIRALTY  
CROWN AGENTS FOR THE COLONIES  
etc., etc.

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## PRODUCTIVE CAPACITY

### 1,000,000 BRICKS WEEKLY

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Silica, Firebrick, and Gas Retort Works :

CASTLECARY (Head Office)

Firebrick Works :

MANUEL, L. & N.E. Railway

Ganister and Firebrick Works :

BONNYBRIDGE, L. & N.E. Railway

Common Red Brick Works :

DENNY, L.M. & S. Railway

Telephone (Head Office): Banknock 55 and 56 (two lines)

Telegraphic Address: "Stein, Bonnybridge"

*Copies of this pamphlet can also be obtained in  
French, German, Spanish, and Russian*

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**O**UR POLICY of using every effort to improve our products has been an important factor in making us the largest Manufacturers of Refractories in the British Empire.

**SELECTION OF REFRACTORIES** should be made after closely studying the requirements of each particular case. The first cost should not be the deciding factor. Continuous production and low maintenance costs demand the use of high-grade refractories in many cases. We have an abundant supply of raw materials drawn from our various mines and we are, therefore, in an exceptional position to supply a complete range of bricks from which it is possible to select one to give the best service under the particular conditions prevailing.

**CO-OPERATION.** We are desirous of co-operating with users to get the maximum efficiency and most economical results. Our technical representatives are always pleased to call and discuss problems. We have a well-equipped laboratory in which routine control work and research are continuously and actively carried out.

**SHAPE AND SIZE.** We give close attention to the production of goods of uniform quality and of accurate shape and size. Accuracy of shape and size is of great importance, as it permits the bricks being built with very thin joints. It is now generally realised that joints are the weakest part of the brickwork and we would emphasise the importance of the use of properly prepared and selected refractory cement, even when thin joints are used.

**CONSTANCY OF VOLUME.** All our products are burned in modern kilns at high temperatures so that after-contraction or after-expansion during the subsequent use of the bricks is reduced to negligible proportions. The mechanical strength of the bricks is also increased by this thorough burning.

**CARE IN LIGHTING UP.** Within recent years considerable research has been done on spalling, and evidence has shown that the most dangerous time for thermal spalling in **Firebricks** is between cold and 800° C. (red heat) and for **Silica Bricks** between cold and 300° C. The danger can be lessened if the user exercises care in the heating up and cooling down through these temperature ranges. It is strongly recommended that lighting up should be done with coal fires, for if wood or oily waste is used the flames may lick the surface of the cold brickwork and cause spalling in the first few moments. A Memo. entitled, "Notes on Spalling in Firebrick," and a pamphlet, "Notes on the Use of Silica Bricks," giving further information on this subject may be had on request.

**SPECIAL SHAPES.** In the design of Special Blocks it is advisable to bear in mind that the presence of sharp angles and recesses increases difficulties in manufacture, and is often the cause of premature failure in use. It is always cheaper to adopt, wherever possible, 9-in. or if necessary 13½-in. sizes in place of Special Shapes.

On page 8 we have set down the purposes for which we recommend each of our Brands. It is impossible to mention all features of our products in a single pamphlet, but we are always glad to give any further information.

10 91-B2858 CORN 24E



## “NETTLE” Brand Firebricks



### Approximate Analysis

|               |   |   |   |   |   |   |         |
|---------------|---|---|---|---|---|---|---------|
| Silica        | . | . | . | . | . | . | 51.30%  |
| Alumina       | . | . | . | . | . | . | 43.69%  |
| Titanic Oxide | . | . | . | . | . | . | 1.50%   |
| Ferric Oxide  | . | . | . | . | . | . | 2.61%   |
| Lime          | . | . | . | . | . | . | 0.41%   |
| Magnesia      | . | . | . | . | . | . | 0.58%   |
| Potash        | . | . | . | . | . | . | 0.04%   |
| Soda          | . | . | . | . | . | . | trace   |
|               |   |   |   |   |   |   | 100.13% |

Refractory test. . . . . Cone 34-35=1760° C. 3200° F.

Refractory test under load 50 lbs.  
square inch . . . . . Cone 27=1610° C. 2930° F.

After-contraction test (fired two hours  
at Cone 14=1410° C.) . . . . . 0.07% after-contraction.

This firebrick is one of the high alumina series, possessing the properties of extreme refractoriness, great resistance to the penetrative action of slags, combined with a high degree of hardness at high temperatures. It is specially suitable for furnace parts which are subjected to particularly high temperatures; the abrasive action of hot, high velocity, dust-laden gases; the corrosive action of alkali fumes and fuel ash.

The ratio  $Al_2O_3 : SiO_2$  in our “Nettle” Brand Firebrick is very similar to that in Kaolin. The result of this is that the final stable products, mullite and some cristobalite, are formed very quickly, whereas materials removed from this ratio only form the final products after long burning, usually when the brick is in service. This characteristic of “Nettle” Clay means that the bricks have valuable properties. They retain constancy of volume at high temperatures, stand up well under load, and, since the excess silica is small in amount, they are not sensitive to rapid changes in temperature.



## “THISTLE” Brand Firebricks



### Approximate Analysis

|               |   |   |   |   |   |   |         |
|---------------|---|---|---|---|---|---|---------|
| Silica        | . | . | . | . | . | . | 55.50%  |
| Alumina       | . | . | . | . | . | . | 37.41%  |
| Titanic Oxide | . | . | . | . | . | . | 0.90%   |
| Ferric Oxide  | . | . | . | . | . | . | 4.57%   |
| Magnesia      | . | . | . | . | . | . | 0.55%   |
| Lime          | . | . | . | . | . | . | 0.49%   |
| Potash        | . | . | . | . | . | . | 0.57%   |
| Soda          | . | . | . | . | . | . | 0.12%   |
|               |   |   |   |   |   |   | <hr/>   |
|               |   |   |   |   |   |   | 100.11% |
|               |   |   |   |   |   |   | <hr/>   |

Refractory test. . . . . Cone 31=1690° C. 3074° F.

Refractory test under load 50 lbs.  
square inch . . . . . Cone 19=1520° C. 2768° F.

After-contraction test (fired two hours  
at Cone 14=1410° C.) . . . 0.03% after-contraction.

“Thistle” Brand Firebricks have long been accepted as a standard among high-grade refractories. Well made and thoroughly burned, this brick is firmly established on the market, and the output of this quality alone approximates 20 millions per annum. It has practically no after-contraction in use at high temperatures, and stands hard wear and tear and rapid changes of temperature without spalling.



## "STEIN" Brand Firebricks



### Approximate Analysis

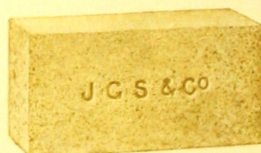
|                |        |
|----------------|--------|
| Silica         | 58.60% |
| Alumina        | 34.50% |
| Ferric Oxide   | 2.86%  |
| Lime           | 0.73%  |
| Magnesia       | 0.45%  |
| Titanium Oxide | 1.30%  |
| Potash         | 1.08%  |
| Soda           | 0.62%  |

100.14%

|                                                                 |                  |                    |
|-----------------------------------------------------------------|------------------|--------------------|
| Refractory test.                                                | Cone 31=1690° C. | 3074° F.           |
| Refractory test under load 50 lbs.<br>square inch               | Cone 19=1520° C. | 2768° F.           |
| After-contraction test (fired two hours<br>at Cone 14=1410° C.) | 0.13%            | after-contraction. |

This is a high-grade firebrick of excellent quality, specially suitable for lining Blast Furnace Stacks, Foundry and Bessemer Cupolas, and Gas Producers.

## "JGS&CO" Semi-Silica Bricks



### Approximate Analysis

|               |        |
|---------------|--------|
| Silica        | 81.20% |
| Alumina       | 15.64% |
| Iron Oxide    | 1.21%  |
| Lime          | 0.29%  |
| Magnesia      | 0.51%  |
| Titanic Oxide | 0.50%  |
| Potash        | 0.46%  |
| Soda          | 0.30%  |

100.11%

|                                                               |                     |                  |
|---------------------------------------------------------------|---------------------|------------------|
| Refractory test.                                              | Cone 30=1670° C.    | 3038° F.         |
| Refractory test under load 50 lbs.<br>square inch             | Cone 20/26=1555° C. | 2830° F.         |
| After-expansion test (fired two hours<br>at Cone 14=1410° C.) | 0.04%               | after-expansion. |

"JGS&CO" is a special quality semi-silica brick which has given excellent service in Soaking Pit and Re-heating Furnace walls, roofs, and other portions subjected to long soaking heats, as it shows no contraction under these conditions.



## “BLUEBELL” Brand Silica Bricks



### Approximate Analysis

|                         |         |
|-------------------------|---------|
| Silica . . . . .        | 95.91%  |
| Alumina . . . . .       | 1.57%   |
| Titanic Oxide . . . . . | 0.08%   |
| Ferric Oxide . . . . .  | 0.50%   |
| Lime . . . . .          | 1.71%   |
| Magnesia . . . . .      | 0.04%   |
| Potash . . . . .        | 0.06%   |
| Soda . . . . .          | 0.19%   |
|                         | <hr/>   |
|                         | 100.06% |

|                                                                         |                           |
|-------------------------------------------------------------------------|---------------------------|
| Refractory test . . . . .                                               | Cone 33=1730° C. 3146° F. |
| Refractory test under load 50 lbs.<br>square inch . . . . .             | Cone 30=1670° C. 3038° F. |
| After-expansion test (fired two hours<br>at Cone 14=1410° C.) . . . . . | 0.098% after-expansion.   |
| After-expansion test (fired two hours,<br>1500° C.) . . . . .           | 0.17% after-expansion.    |

True Specific Gravity, 2.33.

Inversion :—Unconverted quartz, nil. Tridymite, 45% approx.  
Cristobalite and glass, 55% approx.

This brand is burned at a high temperature which ensures that the expansion is practically all taken out in manufacture and results in exceptionally low after-expansion in use. It is also noted for its high degree of mechanical strength.

We would particularly refer to the value of this brick for the lining of By-product Coke Ovens in which salty coals are to be coked. Silica bricks have a much higher resistance to the corrosive action of salty coals than either firebricks or semi-silica bricks. The higher thermal diffusivity and mechanical strength at coking temperatures are factors of considerable importance to the coke oven user. A separate pamphlet, “Notes on the Use of Silica Bricks,” may be had on request.

**SPECIAL (OR SUPER) REFRACTORIES.** We make special Refractories such as Sillimanite which are designed to withstand the most severe conditions in service, in positions where the use of ordinary Refractories would not be economical. We are pleased to furnish particulars of these brands on application.

*Refractory Cements supplied for building  
Firebricks and Silica Bricks*

*Wet and dry ground Ganister supplied for patching  
and daubing Ladles, Cupolas, etc.*



# Service Applications

## TYPE OF FURNACE.

## BRAND RECOMMENDED.

### Blast Furnace—

|                           |                      |
|---------------------------|----------------------|
| Hearth and Bosh . . . . . | "Nettle."            |
| Inwall . . . . .          | "Nettle" or "Stein." |
| Top . . . . .             | "Stein."             |

We recommend the following sizes (all machine pressed) which cover the entire building—  
 $13\frac{1}{2} \times 6 \times 3$  ins.,  $13\frac{1}{2} \times 6\frac{1}{5} \times 3$  ins.,  $13\frac{1}{2} \times 6\frac{3}{4} \times 3$  ins.,  $9 \times 6 \times 3$  ins.,  $9 \times 6\frac{3}{8} \times 3$  ins.,  $9 \times 6\frac{13}{16} \times 3$  ins. See diagram on page 10 for detail of building.

Hot Blast Stove . . . . . "Stein" and "Nettle."

### Open Hearth Furnace—

|                                                      |                                  |
|------------------------------------------------------|----------------------------------|
| Crowns, Ports, and Side Walls . . . . .              | "Bluebell."                      |
| Slag Pockets . . . . .                               | "Nettle."                        |
| Furnace Doors . . . . .                              | "Nettle," "Thistle," "Stein."    |
| Regenerators—Walls, Crown and Checker work . . . . . | "Thistle," "Nettle," "Bluebell." |

We have special designs of checker shapes to give higher efficiency.

### Ladles—

|                                                       |                    |                     |
|-------------------------------------------------------|--------------------|---------------------|
| Lining . . . . .                                      | } Special Quality. | "Thistle," "Stein." |
| Stopper Sleeves . . . . .                             |                    |                     |
| Stoppers and Nozzles . . . . .                        |                    |                     |
| Centres and Runner Brick for bottom casting . . . . . |                    |                     |

### Electric Furnaces—

|                                |           |
|--------------------------------|-----------|
| Crown and Side Walls . . . . . | "Nettle." |
|--------------------------------|-----------|

### Producers—

|                         |           |
|-------------------------|-----------|
| Moderate Duty . . . . . | "Stein."  |
| Heavy Duty . . . . .    | "Nettle." |

### Re-heating and Soaking Furnaces . . . . .

"Nettle," "Thistle," "Stein,"  
 "JGS&CO."

Annealing Furnaces . . . . . "Thistle."

Cupolas . . . . . "Thistle," "Stein."

Air or Reverberatory Furnaces . . . . . "Nettle," "Thistle."

Tube Welding Furnaces . . . . . "Nettle," "Thistle."

### Mill Furnaces—

(Tinplate and Sheet Trades) . . . . . "Nettle," "Thistle."

Coke Ovens . . . . . "Bluebell."

Pulverised Fuel and Oil Fired Furnaces . . . . . "Nettle," "Thistle."

Water Tube Boilers . . . . . "Nettle," "Thistle," "JGS&CO."

Suspended Arches Detrick, Lip-tak, Karrena, etc., for Boilers and Industrial Furnaces . . . . . "Nettle," "Thistle."

Special Positions Involving Ex-treme Temperatures . . . . . "Sillimanite."

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## Thermal Properties of Refractories

It is frequently desirable to have some idea of the order of magnitude of the thermal properties of refractories. Data for, say, specific heat and thermal conductivity are often useful in ascertaining, even approximately, the thermal characteristics of furnaces. If the apparent specific gravity of the refractory is known one can easily find the thermal capacity, for Thermal Capacity=Specific Heat×Apparent Specific Gravity.

The diffusivity, or rate of temperature change in the refractory, is found from the relation

$$\text{Diffusivity} = \frac{\text{Thermal Conductivity}}{\text{Specific Heat} \times \text{Apparent Specific Gravity}}.$$

To give representative thermal data the following have been taken from a paper by A. T. Green (Trans. Eng. Cer. Soc., 1925, 4, 361).

### Specific Heat at Definite Temperatures

|                                          | 25° C. | 200° C. | 400° C. | 600° C. | 800° C. | 1000° C. | 1200° C. | 1400° C. |
|------------------------------------------|--------|---------|---------|---------|---------|----------|----------|----------|
| Fireclay Products }<br>Silica Products } | 0.193  | 0.213   | 0.245   | 0.278   | 0.304   | 0.314    | 0.323    | 0.332    |
|                                          |        | 0.219   | 0.253   | 0.279   | 0.298   | 0.312    | 0.324    | 0.334    |

### Thermal Conductivity at Definite Temperatures

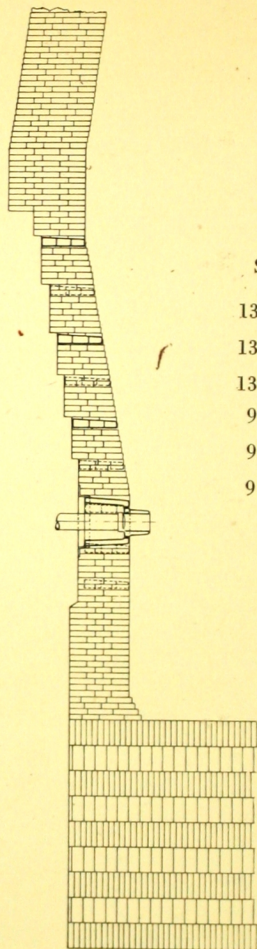
|                                          | 600° C. | 700° C. | 800° C. | 900° C. | 1000° C. | 1100° C. | 1200° C. | 1300° C. |
|------------------------------------------|---------|---------|---------|---------|----------|----------|----------|----------|
| Fireclay Products }<br>Silica Products } | 0.00145 | 0.00155 | 0.00163 | 0.0017  | 0.0018   | 0.00195  | 0.00215  | 0.0023   |
|                                          | 0.0014  | 0.00145 | 0.00155 | 0.00165 | 0.0018   | 0.0020   | 0.0022   | 0.00245  |

## Melting Points of Seger Cones

| Cone No. | Cent. | Fahr. | Cone No. | Cent. | Fahr. | Cone No. | Cent. | Fahr. |
|----------|-------|-------|----------|-------|-------|----------|-------|-------|
| 05a      | 1000  | 1832  | 10       | 1300  | 2372  | 29       | 1650  | 3002  |
| 04a      | 1020  | 1868  | 11       | 1320  | 2408  | 30       | 1670  | 3038  |
| 03a      | 1040  | 1904  | 12       | 1350  | 2462  | 31       | 1690  | 3074  |
| 02a      | 1060  | 1940  | 13       | 1380  | 2516  | 32       | 1710  | 3110  |
| 01a      | 1080  | 1976  | 14       | 1410  | 2570  | 33       | 1730  | 3146  |
| 1a       | 1100  | 2012  | 15       | 1435  | 2615  | 34       | 1750  | 3182  |
| 2a       | 1120  | 2048  | 16       | 1460  | 2660  | 35       | 1770  | 3218  |
| 3a       | 1140  | 2084  | 17       | 1480  | 2696  | 36       | 1790  | 3254  |
| 4a       | 1160  | 2120  | 18       | 1500  | 2732  | 37       | 1825  | 3317  |
| 5a       | 1180  | 2156  | 19       | 1520  | 2768  | 38       | 1850  | 3362  |
| 6a       | 1200  | 2192  | 20       | 1530  | 2786  | 39       | 1880  | 3416  |
| 7        | 1230  | 2246  | 26       | 1580  | 2876  | 40       | 1920  | 3488  |
| 8        | 1250  | 2282  | 27       | 1610  | 2930  | 41       | 1960  | 3560  |
| 9        | 1280  | 2336  | 28       | 1630  | 2966  | 42       | 2000  | 3632  |



## Section of Blast Furnace Lined with Machine-pressed Bricks



### SIZES USED

$13\frac{1}{2} \times 6 \times 3$  ins.

$13\frac{1}{2} \times 6\frac{1}{5} \times 3$  ins.

$13\frac{1}{2} \times 6\frac{3}{8} \times 3$  ins.

$9 \times 6 \times 3$  ins.

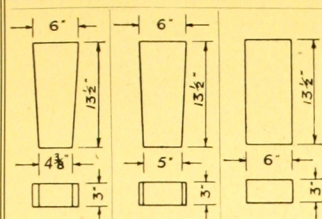
$9 \times 6\frac{5}{8} \times 3$  ins.

$9 \times 6\frac{13}{16} \times 3$  ins.

| Table showing<br>Bricks to                    |                |  |
|-----------------------------------------------|----------------|--|
| Internal<br>Diameter<br>of Lining<br>Ft. Ins. | 13 1/2 x 6 1/2 |  |
| 6 0                                           | 52             |  |
| 6 6                                           | 48             |  |
| 7 0                                           | 42             |  |
| 7 6                                           | 37             |  |
| 8 0                                           | 33             |  |
| 8 6                                           | 28             |  |
| 9 0                                           | 23             |  |
| 9 6                                           | 18             |  |
| 10 0                                          | 12             |  |
| 10 6                                          | 7              |  |
| 11 0                                          | 2              |  |
| 11 3                                          | —              |  |
| 11 6                                          | —              |  |
| 12 0                                          | —              |  |
| 12 6                                          | —              |  |
| 13 0                                          | —              |  |
| 13 6                                          | —              |  |
| 14 0                                          | —              |  |
| 14 6                                          | —              |  |
| 15 0                                          | —              |  |
| 15 6                                          | —              |  |
| 16 0                                          | —              |  |
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| 31 6                                          | —              |  |
| 32 0                                          | —              |  |
| 32 6                                          | —              |  |
| 33 0                                          | —              |  |
| 33 6                                          | —              |  |
| 34 0                                          | —              |  |
| 34 6                                          | —              |  |
| 35 0                                          | —              |  |



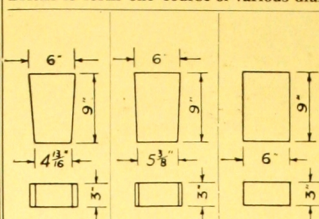
Table showing quantities 13½-in. Key and Square Bricks to form one course of various diameters.



13½ × 6/4½ × 3 ins. 13½ × 6/5 × 3 ins. 13½ × 6 × 3 ins.

Total.

Table showing quantities 9-in. Key and Square Bricks to form one course of various diameters.



9 × 6/4½ × 3 ins. 9 × 6/5½ × 3 ins. 9 × 6 × 3 ins.

Total.

| Internal Diameter of Lining. | 13½ × 6/4½ × 3 ins. | 13½ × 6/5 × 3 ins. | 13½ × 6 × 3 ins. | Total. | 9 × 6/4½ × 3 ins. | 9 × 6/5½ × 3 ins. | 9 × 6 × 3 ins. | Total. |
|------------------------------|---------------------|--------------------|------------------|--------|-------------------|-------------------|----------------|--------|
| Ft. Ins.                     |                     |                    |                  |        |                   |                   |                |        |
| 6 0                          | 52                  | —                  | —                | 52     | 47                | —                 | —              | 47     |
| 6 6                          | 48                  | 7                  | —                | 55     | 44                | 6                 | —              | 50     |
| 7 0                          | 42                  | 16                 | —                | 58     | 42                | 12                | —              | 54     |
| 7 6                          | 37                  | 24                 | —                | 61     | 38                | 19                | —              | 57     |
| 8 0                          | 33                  | 32                 | —                | 65     | 34                | 26                | —              | 60     |
| 8 6                          | 28                  | 40                 | —                | 68     | 31                | 32                | —              | 63     |
| 9 0                          | 23                  | 48                 | —                | 71     | 27                | 39                | —              | 66     |
| 9 6                          | 18                  | 56                 | —                | 74     | 23                | 46                | —              | 69     |
| 10 0                         | 12                  | 65                 | —                | 77     | 20                | 52                | —              | 72     |
| 10 6                         | 7                   | 73                 | —                | 80     | 16                | 59                | —              | 75     |
| 11 0                         | 2                   | 81                 | —                | 83     | 13                | 66                | —              | 79     |
| 11 3                         | —                   | 85                 | —                | 85     | —                 | —                 | —              | —      |
| 11 6                         | —                   | 85                 | 2                | 87     | 10                | 72                | —              | 82     |
| 12 0                         | —                   | 85                 | 5                | 90     | 6                 | 79                | —              | 85     |
| 12 6                         | —                   | 85                 | 8                | 93     | 3                 | 85                | —              | 88     |
| 13 0                         | —                   | 85                 | 11               | 96     | —                 | 91                | —              | 91     |
| 13 6                         | —                   | 85                 | 14               | 99     | —                 | 91                | 3              | 94     |
| 14 0                         | —                   | 85                 | 17               | 102    | —                 | 91                | 6              | 97     |
| 14 6                         | —                   | 85                 | 21               | 106    | —                 | 91                | 10             | 101    |
| 15 0                         | —                   | 85                 | 24               | 109    | —                 | 91                | 13             | 104    |
| 15 6                         | —                   | 85                 | 27               | 112    | —                 | 91                | 16             | 107    |
| 16 0                         | —                   | 85                 | 30               | 115    | —                 | 91                | 19             | 110    |
| 16 6                         | —                   | 85                 | 33               | 118    | —                 | 91                | 22             | 113    |
| 17 0                         | —                   | 85                 | 36               | 121    | —                 | 91                | 25             | 116    |
| 17 6                         | —                   | 85                 | 39               | 124    | —                 | 91                | 28             | 119    |
| 18 0                         | —                   | 85                 | 43               | 128    | —                 | 91                | 32             | 123    |
| 18 6                         | —                   | 85                 | 46               | 131    | —                 | 91                | 35             | 126    |
| 19 0                         | —                   | 85                 | 49               | 134    | —                 | 91                | 38             | 129    |
| 19 6                         | —                   | 85                 | 52               | 137    | —                 | 91                | 41             | 132    |
| 20 0                         | —                   | 85                 | 55               | 140    | —                 | 91                | 44             | 135    |
| 20 6                         | —                   | 85                 | 58               | 143    | —                 | 91                | 47             | 138    |
| 21 0                         | —                   | 85                 | 61               | 146    | —                 | 91                | 50             | 141    |
| 21 6                         | —                   | 85                 | 65               | 150    | —                 | 91                | 54             | 145    |
| 22 0                         | —                   | 85                 | 68               | 153    | —                 | 91                | 57             | 148    |
| 22 6                         | —                   | 85                 | 71               | 156    | —                 | 91                | 60             | 151    |
| 23 0                         | —                   | 85                 | 74               | 159    | —                 | 91                | 63             | 154    |
| 23 6                         | —                   | 85                 | 77               | 162    | —                 | 91                | 66             | 157    |
| 24 0                         | —                   | 85                 | 80               | 165    | —                 | 91                | 69             | 160    |
| 24 6                         | —                   | 85                 | 83               | 168    | —                 | 91                | 72             | 163    |
| 25 0                         | —                   | 85                 | 87               | 172    | —                 | 91                | 76             | 167    |
| 25 6                         | —                   | 85                 | 90               | 175    | —                 | 91                | 79             | 170    |
| 26 0                         | —                   | 85                 | 93               | 178    | —                 | 91                | 82             | 173    |
| 26 6                         | —                   | 85                 | 96               | 181    | —                 | 91                | 85             | 176    |
| 27 0                         | —                   | 85                 | 99               | 184    | —                 | 91                | 88             | 179    |
| 27 6                         | —                   | 85                 | 102              | 187    | —                 | 91                | 91             | 182    |
| 28 0                         | —                   | 85                 | 105              | 190    | —                 | 91                | 94             | 185    |
| 28 6                         | —                   | 85                 | 109              | 194    | —                 | 91                | 98             | 189    |
| 29 0                         | —                   | 85                 | 112              | 197    | —                 | 91                | 101            | 192    |
| 29 6                         | —                   | 85                 | 115              | 200    | —                 | 91                | 104            | 195    |
| 30 0                         | —                   | 85                 | 118              | 203    | —                 | 91                | 107            | 198    |
| 30 6                         | —                   | 85                 | 121              | 206    | —                 | 91                | 110            | 201    |
| 31 0                         | —                   | 85                 | 124              | 209    | —                 | 91                | 113            | 204    |
| 31 6                         | —                   | 85                 | 127              | 212    | —                 | 91                | 117            | 208    |
| 32 0                         | —                   | 85                 | 131              | 216    | —                 | 91                | 120            | 211    |
| 32 6                         | —                   | 85                 | 134              | 219    | —                 | 91                | 123            | 214    |
| 33 0                         | —                   | 85                 | 137              | 222    | —                 | 91                | 126            | 217    |
| 33 6                         | —                   | 85                 | 140              | 225    | —                 | 91                | 129            | 220    |
| 34 0                         | —                   | 85                 | 143              | 228    | —                 | 91                | 132            | 223    |
| 34 6                         | —                   | 85                 | 146              | 231    | —                 | 91                | 135            | 226    |
| 35 0                         | —                   | 85                 | 149              | 234    | —                 | 91                | 138            | 229    |





### **43·69% Alumina**

Refractory test—Cone 34-35.

1760° C. 3200° F.



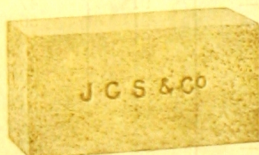
### **37·41% Alumina**

Refractory test—Cone 31. 1690° C. 3074° F.



### **34·50% Alumina**

Refractory test—Cone 31. 1690° C. 3074° F.



### **81·20% Silica**

Refractory test—Cone 30. 1670° C. 3038° F.



### **95·91% Silica**

Refractory test—Cone 33. 1730° C. 3146° F.